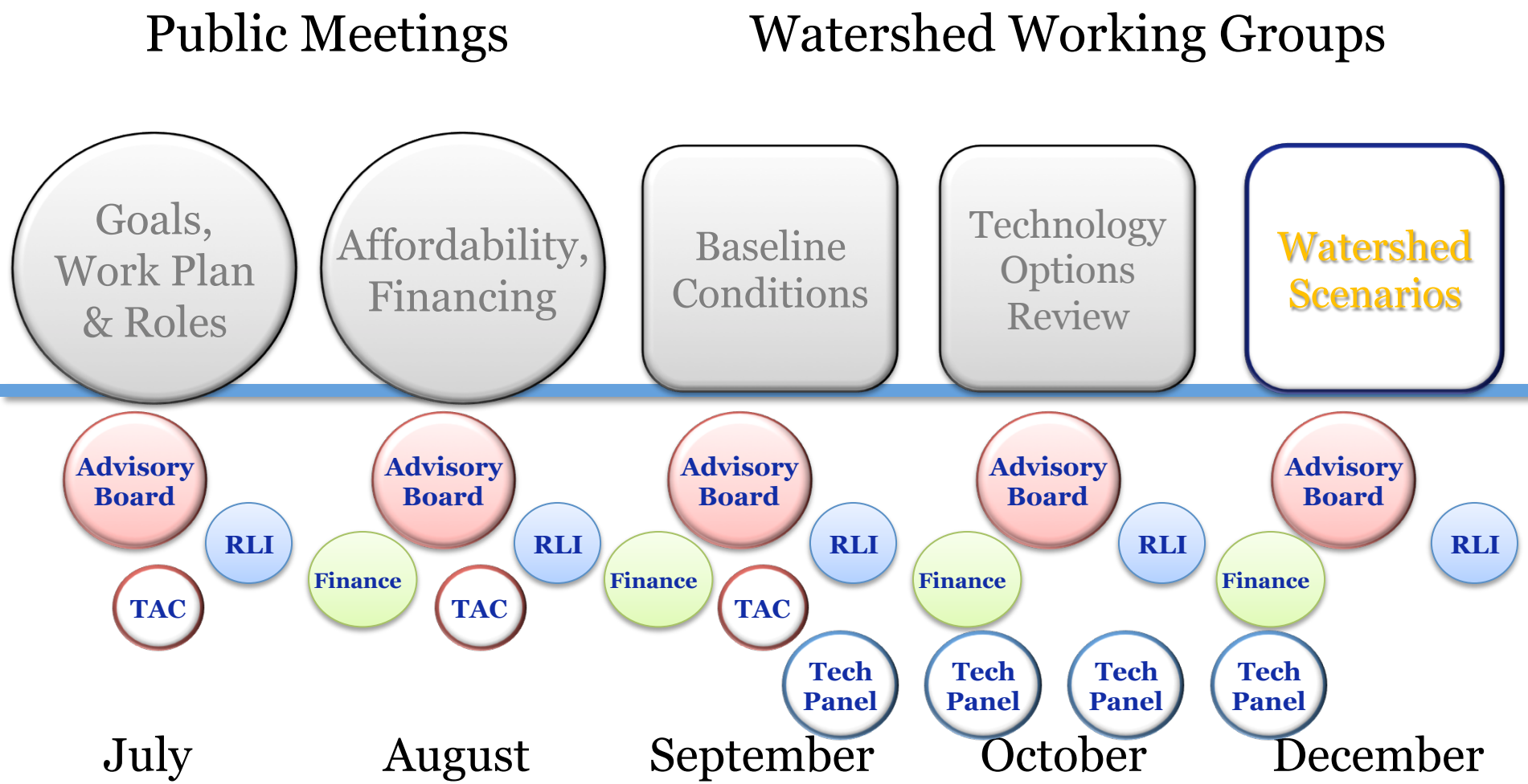
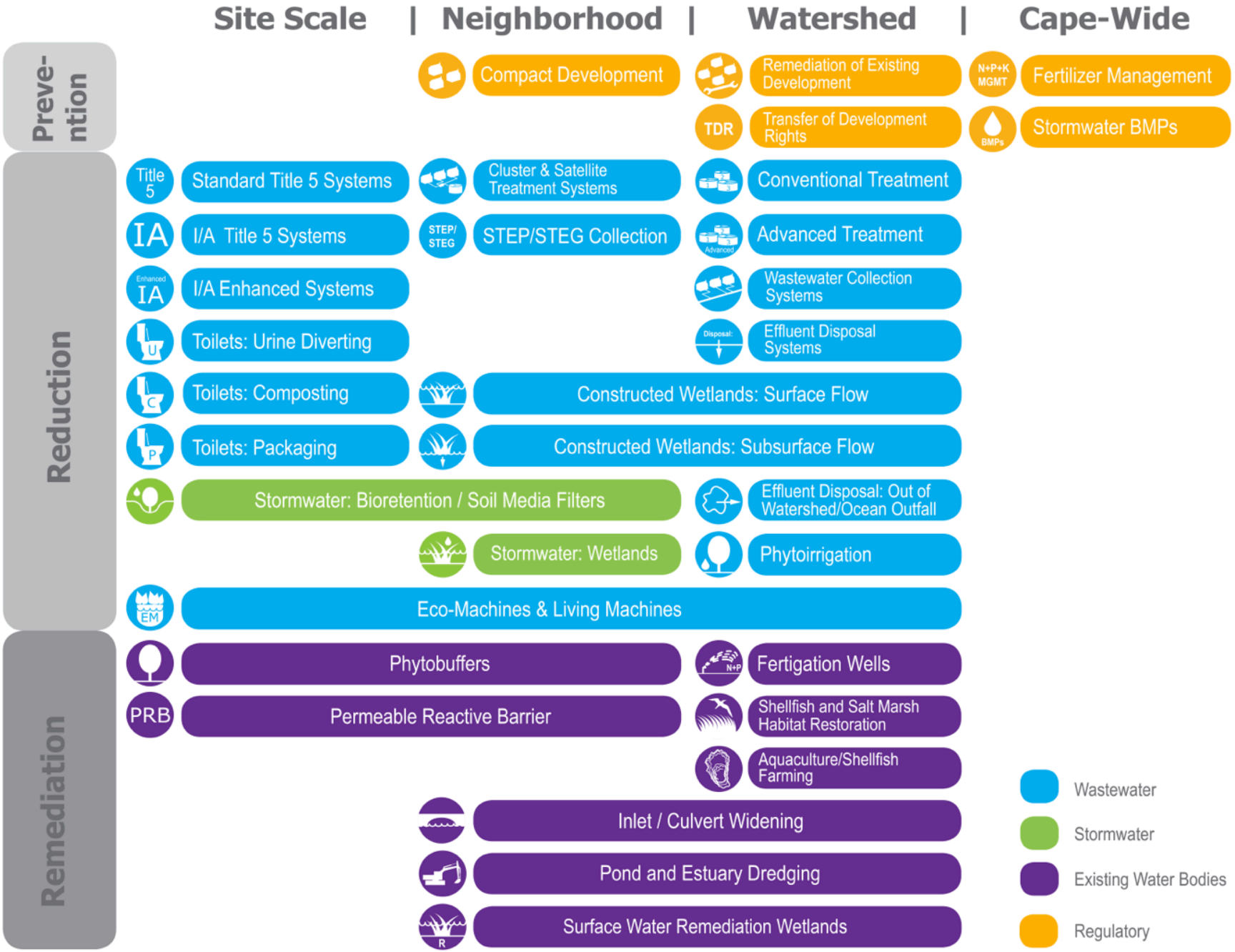
Waquoit Bay & Popponesset Bay Group

Watershed Scenarios



208 Planning Process


Site Scale | Neighborhood | Watershed | Cape-Wide
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Remediation
Compact Development
Remediation of Existing Development
N+P+K MGMT
Fertilizer Management
TDR
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BMPs
Stormwater BMPs
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I/A Title 5 Systems
STEP/ STEG
STEP/STEG Collection
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Toilets: Urine Diverting
Disposal:
Effluent Disposal Systems
C
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Toilets: Packaging
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N+P
Fertigation Wells
PRB
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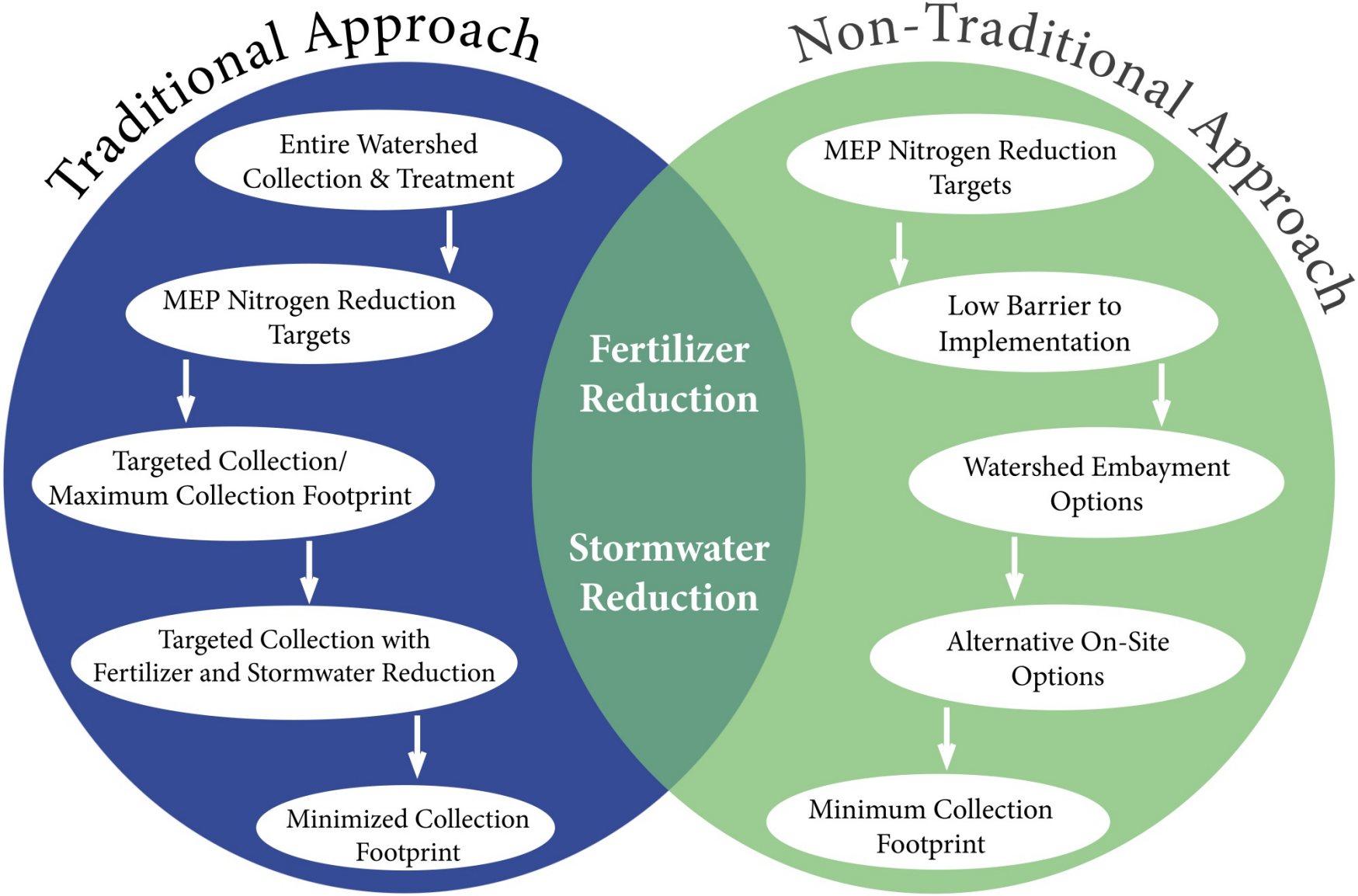
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
R
Surface Water Remediation Wetlands
Wastewater
Stormwater
Existing Water Bodies
Regulatory

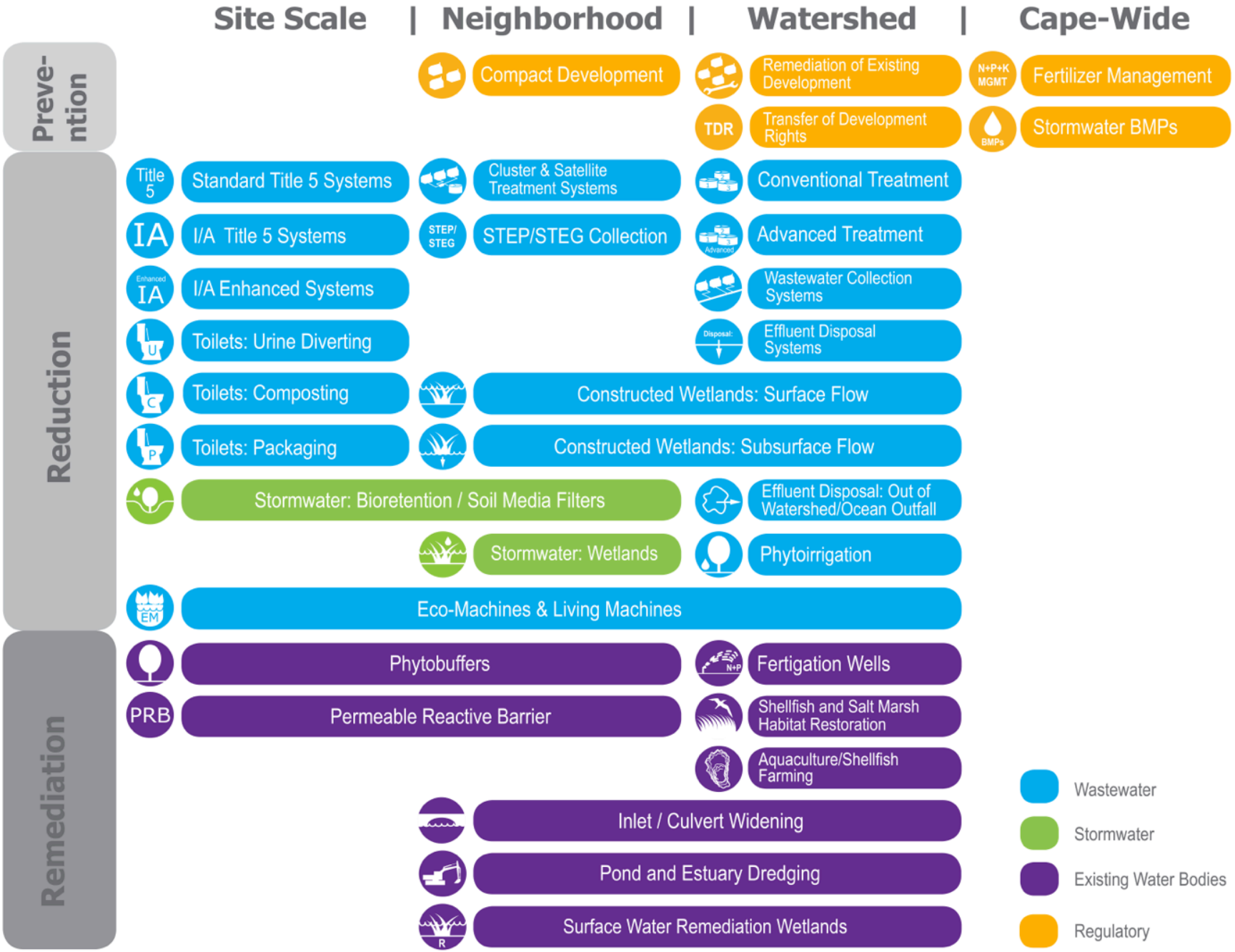
Watershed Scenarios

11 Working Group Meetings: Dec 2-11

Goal of Today's Meeting:

- To discuss the approach for developing watershed scenarios that will remediate water quality impairments in your watersheds.
- To identify preferences, advantages and disadvantages of a set of scenarios of different technologies and approaches, and
- To develop a set of adaptive management principles to guide sub-regional groups in refining scenarios for the 208 Plan.


Traditional Approach
Entire Watershed Collection & Treatment
MEP Nitrogen Reduction Targets
Targeted Collection/ Maximum Collection Footprint
Targeted Collection with Fertilizer and Stormwater Reduction
Minimized Collection Footprint
Fertilizer Reduction
Stormwater Reduction
Non-Traditional Approach
MEP Nitrogen Reduction Targets
Low Barrier to Implementation
Watershed Embayment Options
Alternative On-Site Options
Minimum Collection Footprint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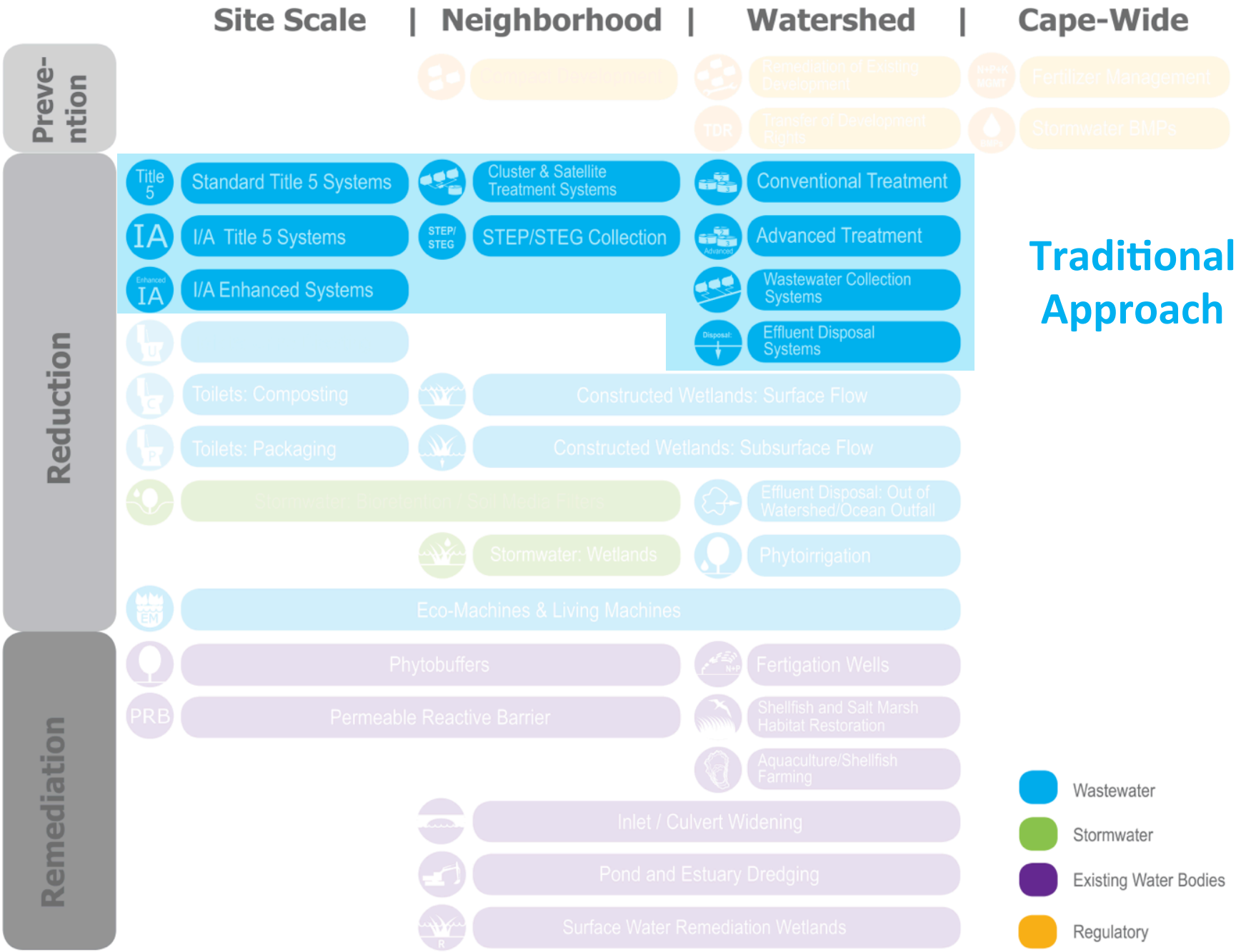
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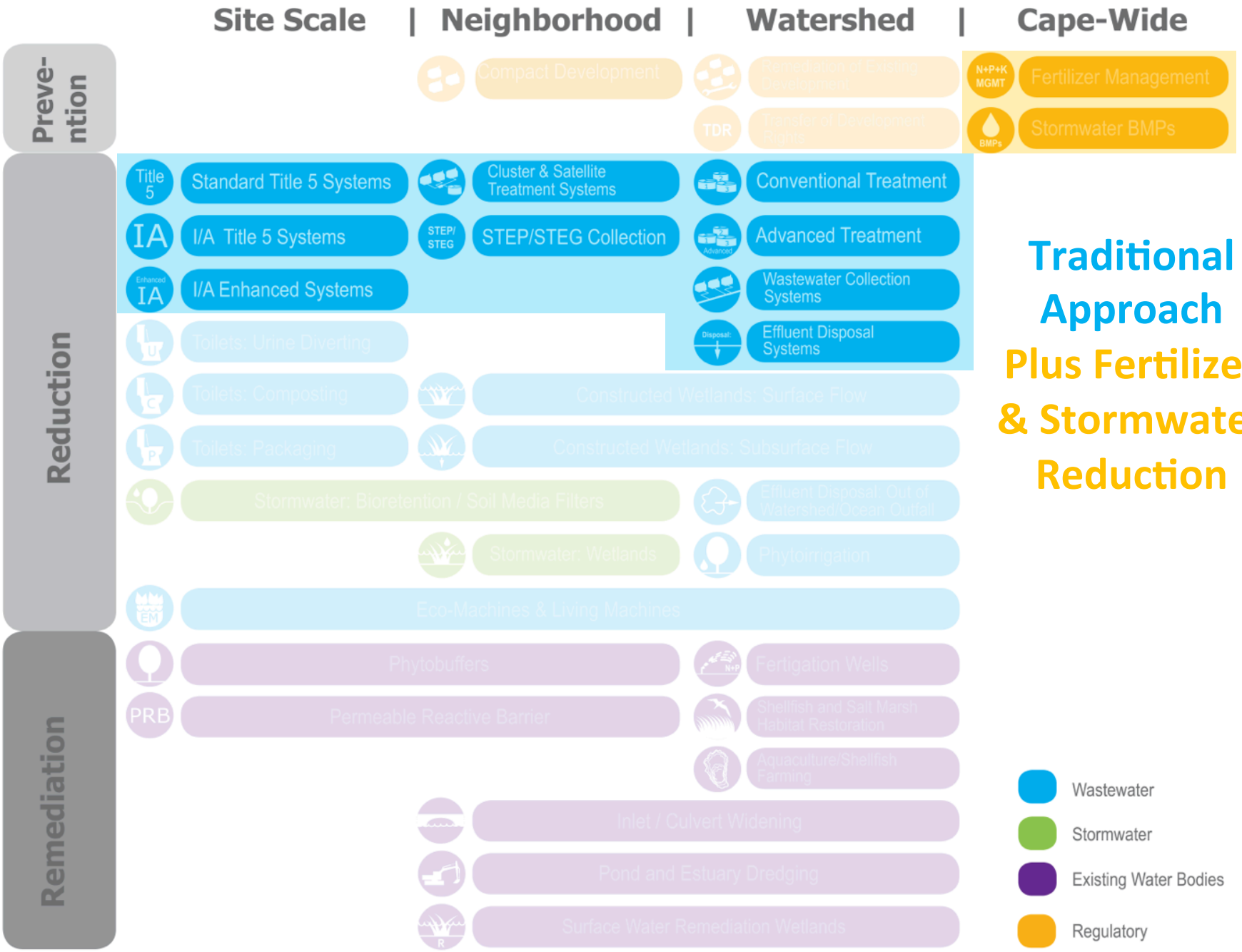
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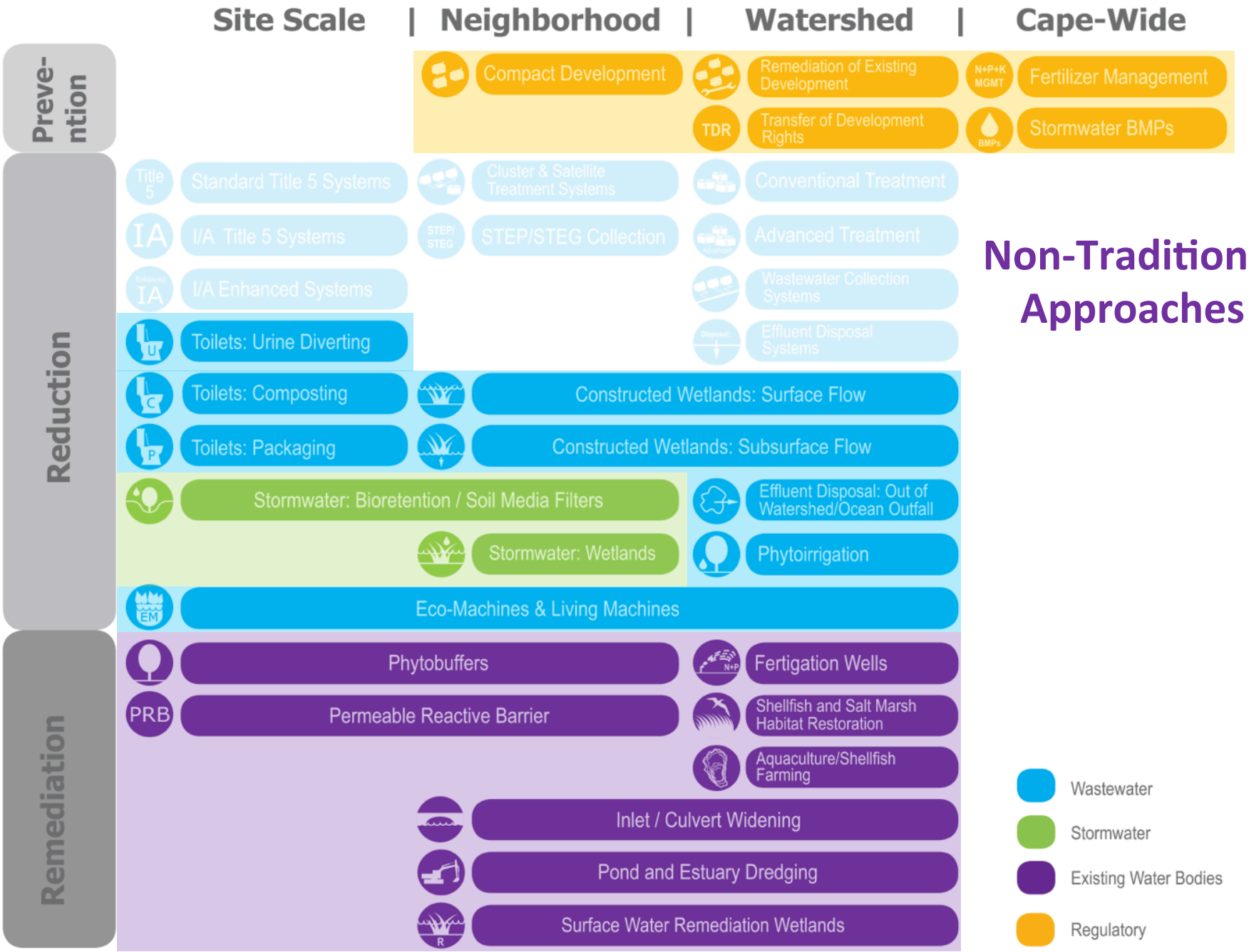
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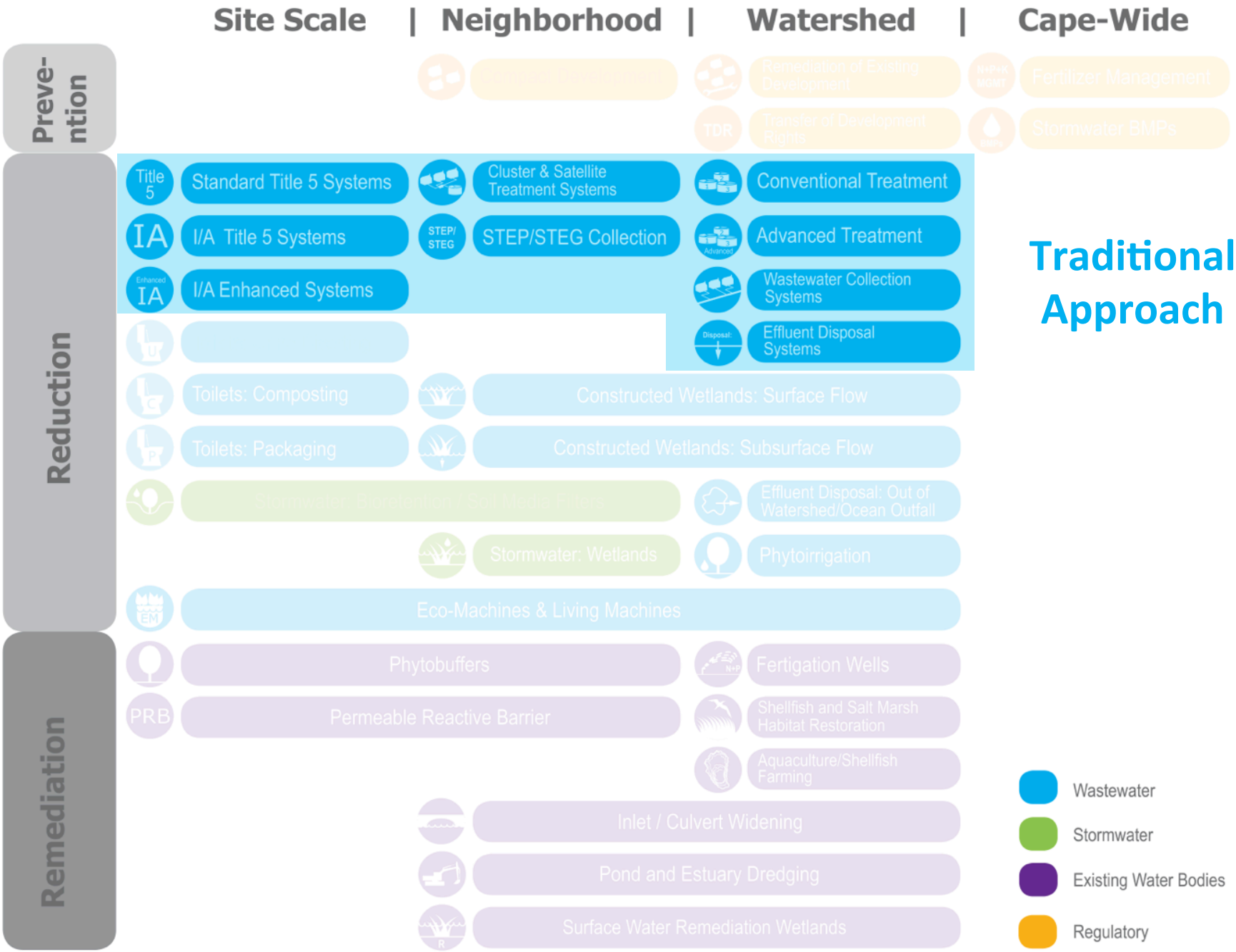
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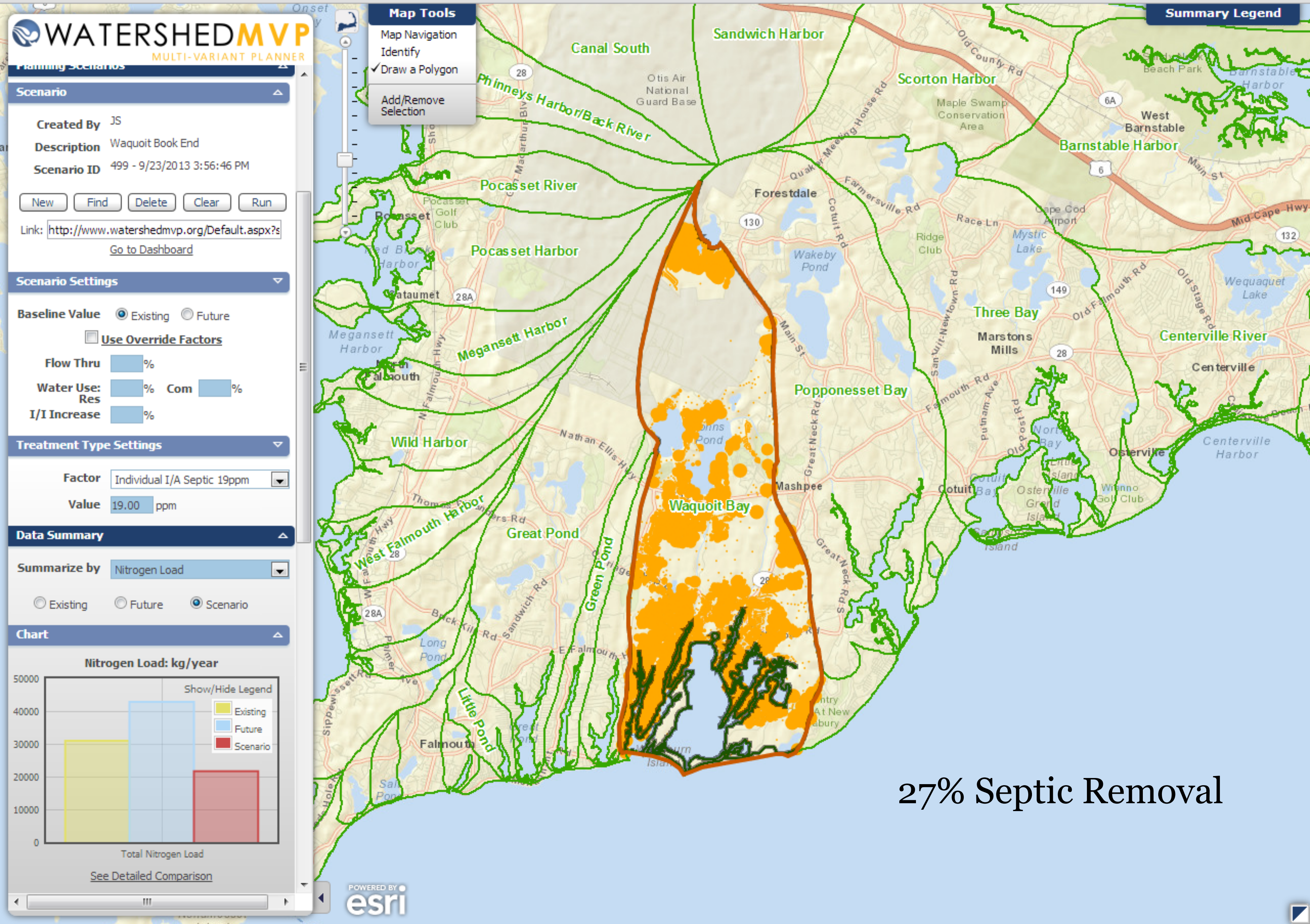
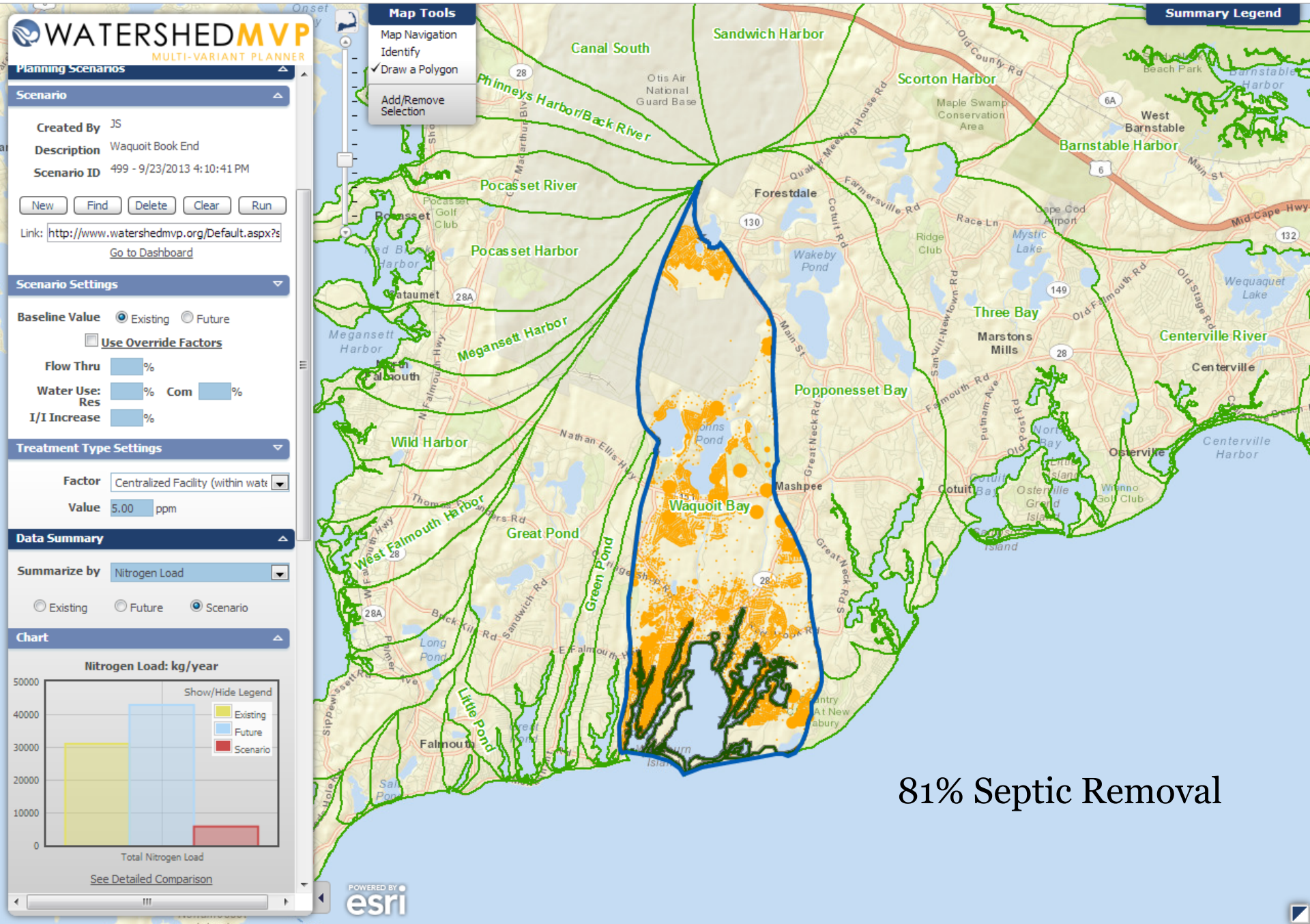
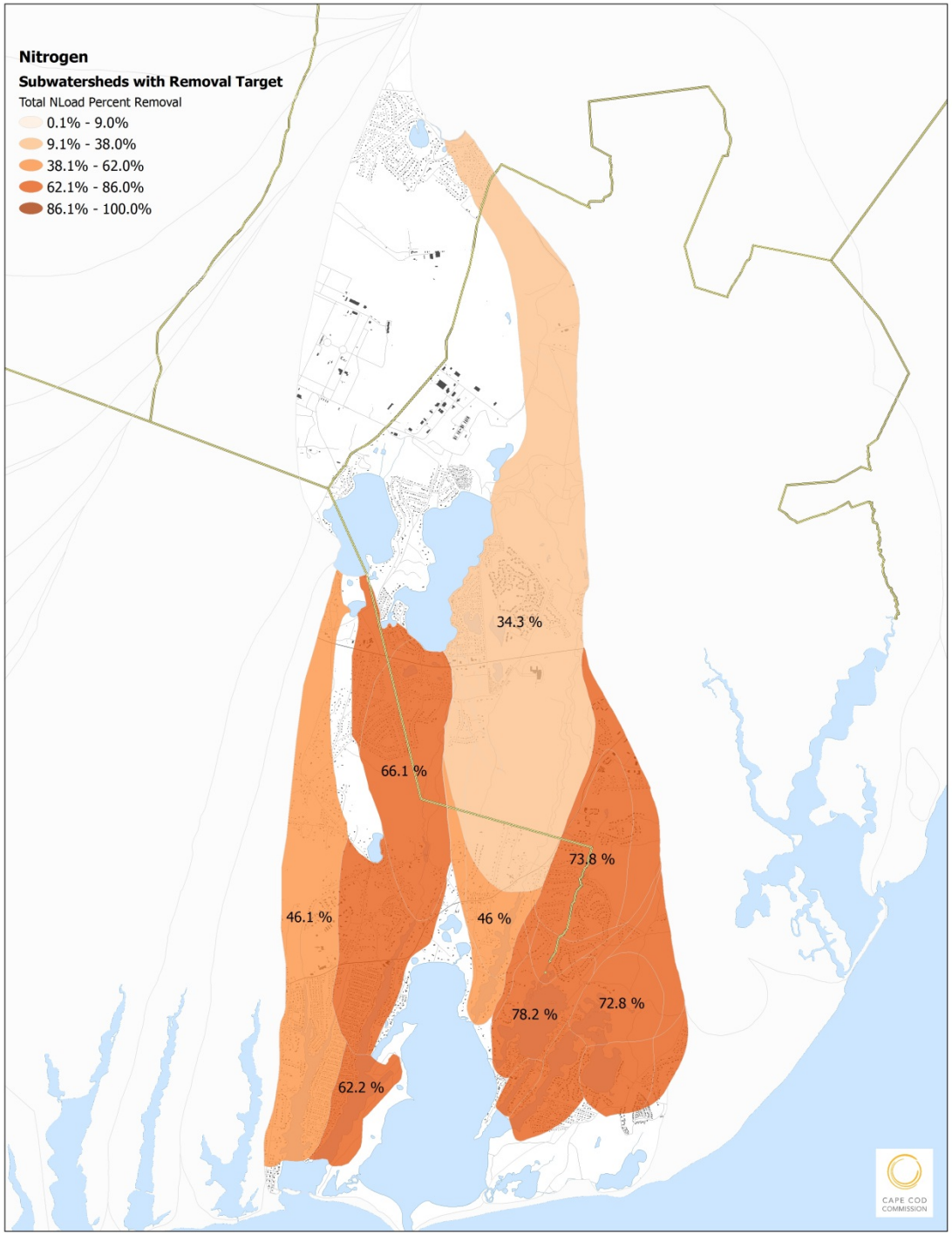
Watershed-Wide Innovative/Alternative (I/A) Onsite Systems

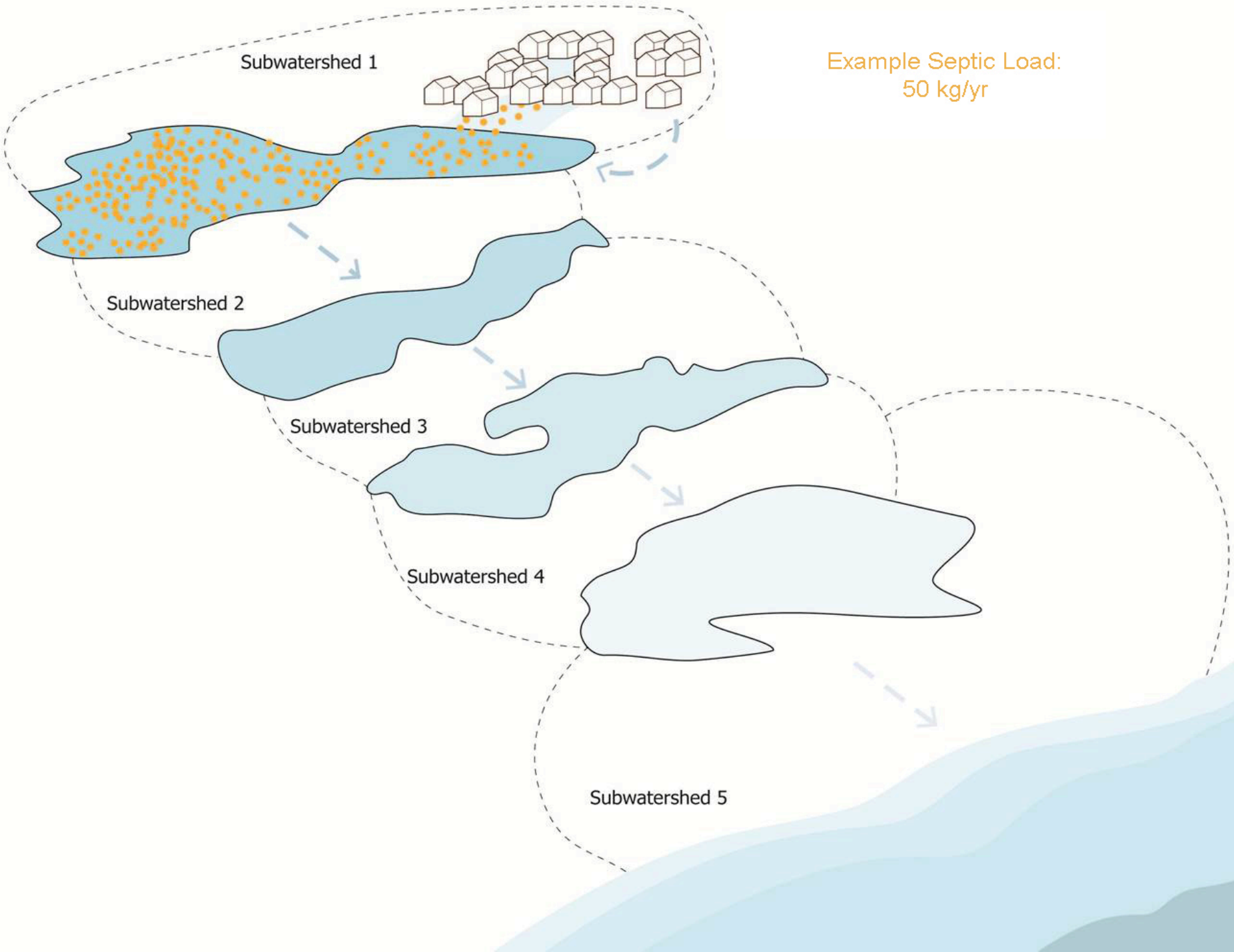


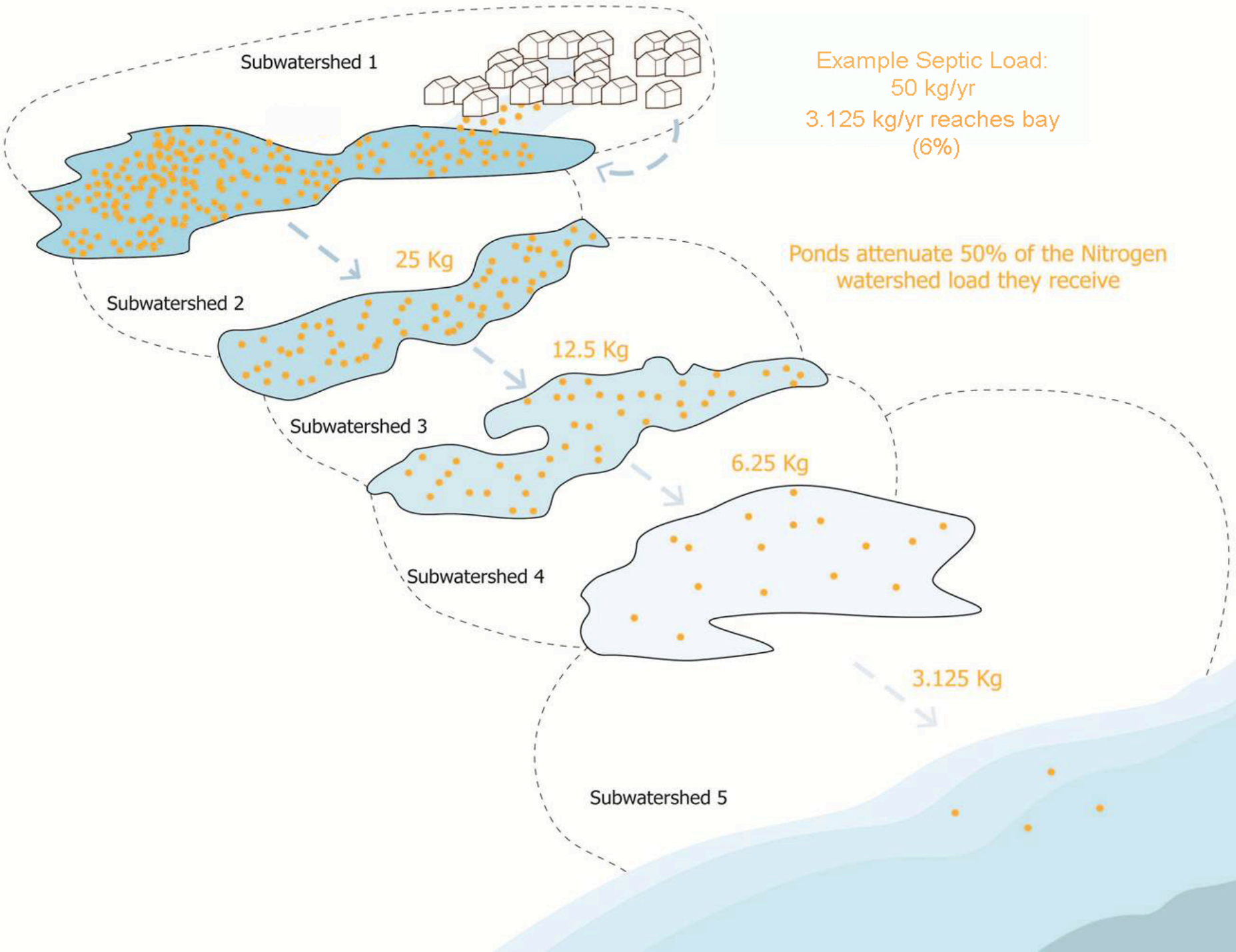
27% Septic Removal

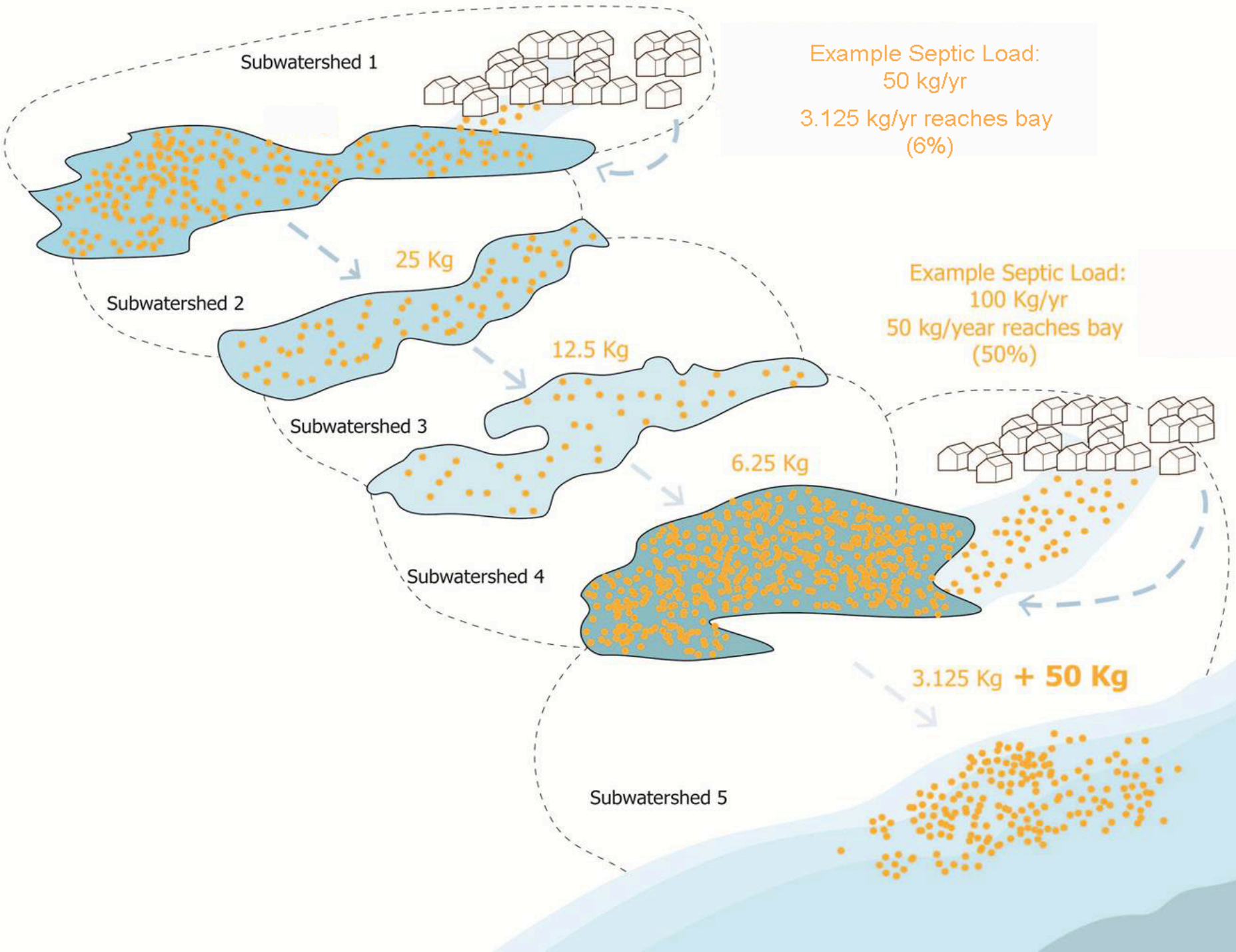
Watershed-Wide Centralized Treatment with Disposal Inside the Watershed




Nitrogen
Subwatersheds with Removal Target
Total NLoad Percent Removal
0.1% - 9.0%
9.1% - 38.0%
38.1% - 62.0%
62.1% - 86.0%
86.1% - 100.0%
34.3 %
66.1 %
73.8 %
46.1 %
46 %
78.2 %
72.8 %
62.2 %
CAPE COD COMMISSION


Subwatershed 1
Example Septic Load:
50 kg/yr
Subwatershed 2
Subwatershed 3
Subwatershed 4
Subwatershed 5


Subwatershed 1
Example Septic Load:
50 kg/yr
3.125 kg/yr reaches bay
(6%)
25 Kg
Subwatershed 2
Ponds attenuate 50% of the Nitrogen
watershed load they receive
12.5 Kg
Subwatershed 3
6.25 Kg
Subwatershed 4
3.125 Kg
Subwatershed 5


Subwatershed 1
Example Septic Load:
50 kg/yr
3.125 kg/yr reaches bay
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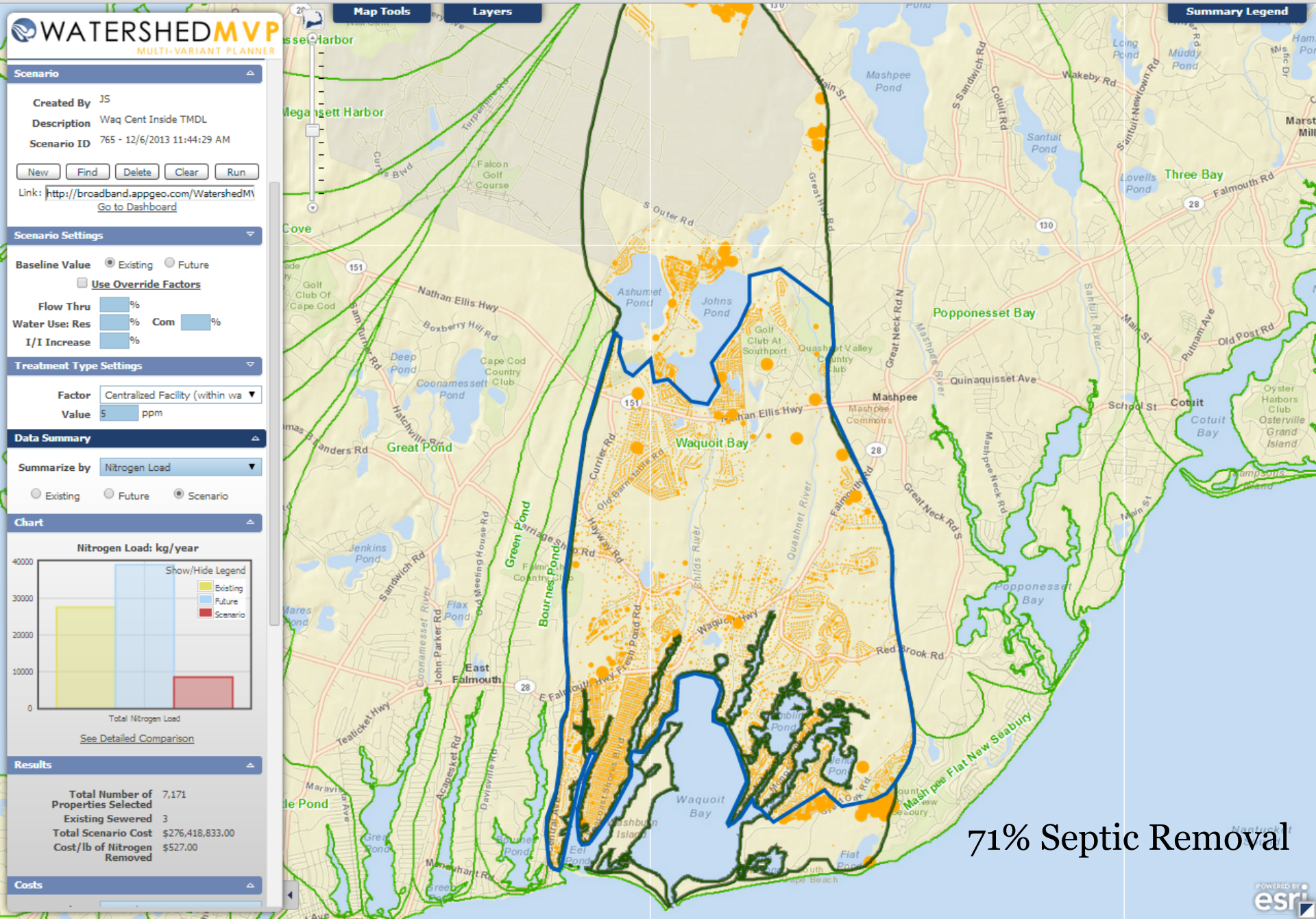
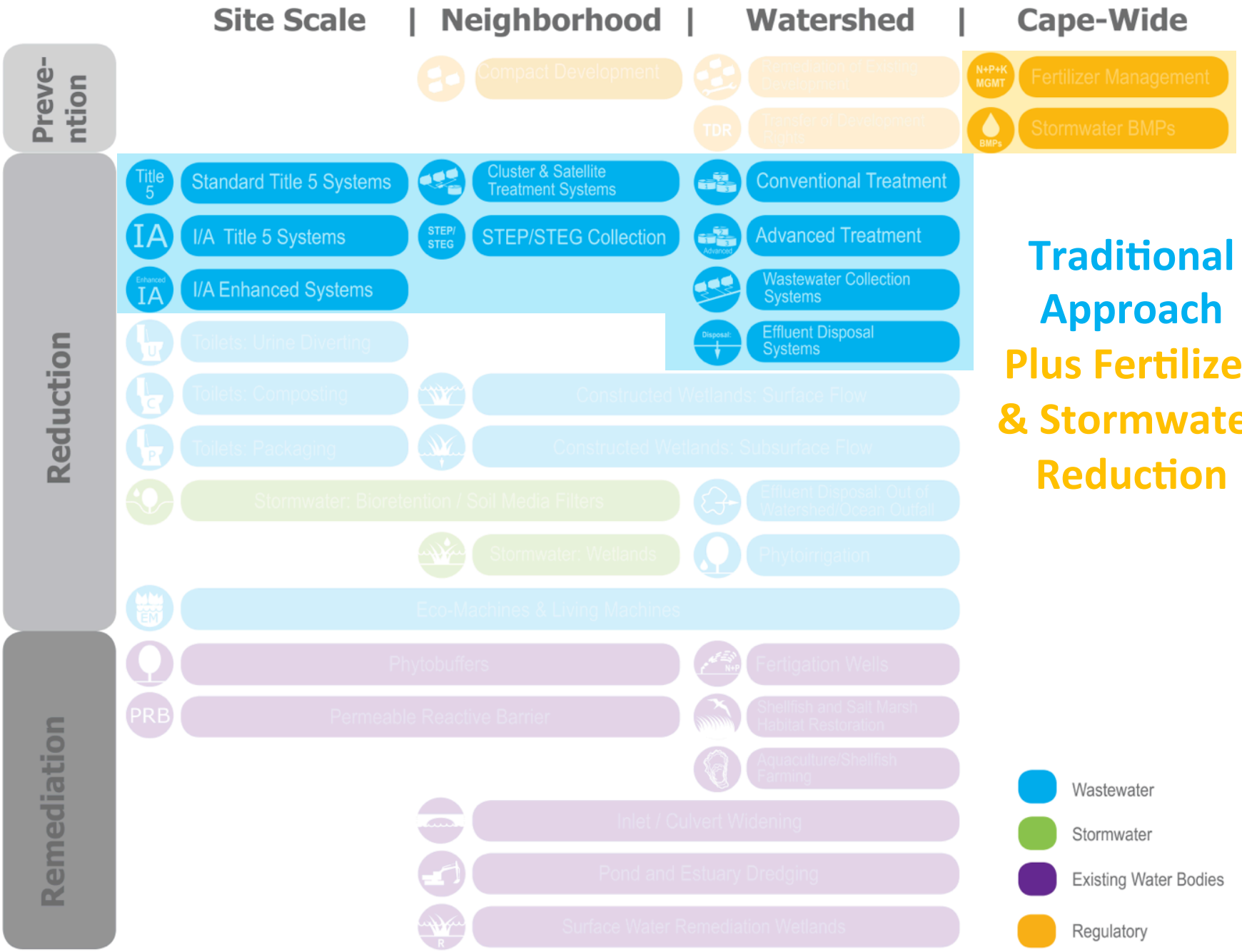
25 Kg
Subwatershed 2
Example Septic Load:
100 Kg/yr
50 kg/year reaches bay
(50%)
12.5 Kg
Subwatershed 3
6.25 Kg
Subwatershed 4
3.125 Kg + 50 Kg
Subwatershed 5

Targeted Centralized Treatment with Disposal Inside the Watershed

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Traditional Approach Plus Fertilizer & Stormwater Reduction
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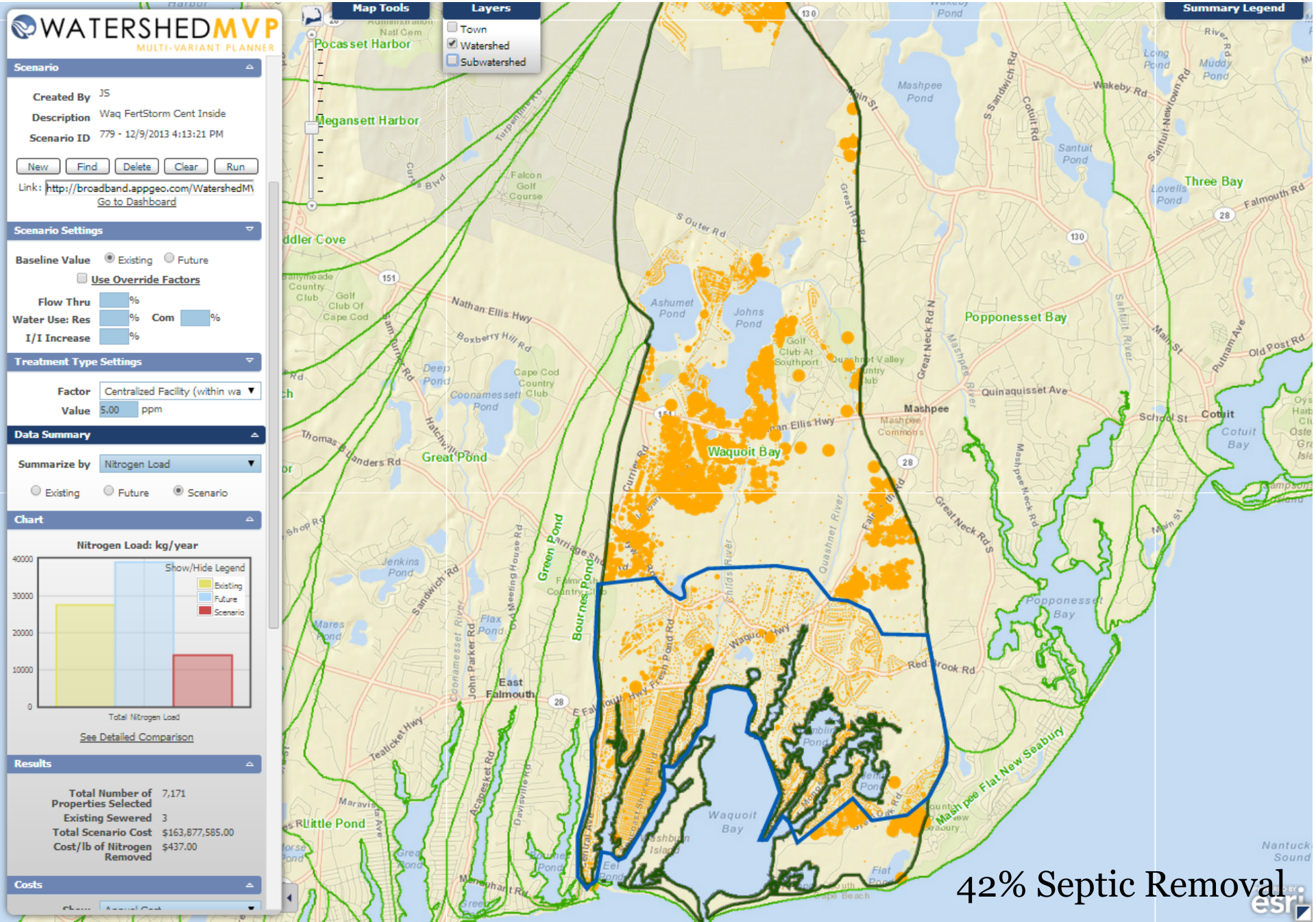
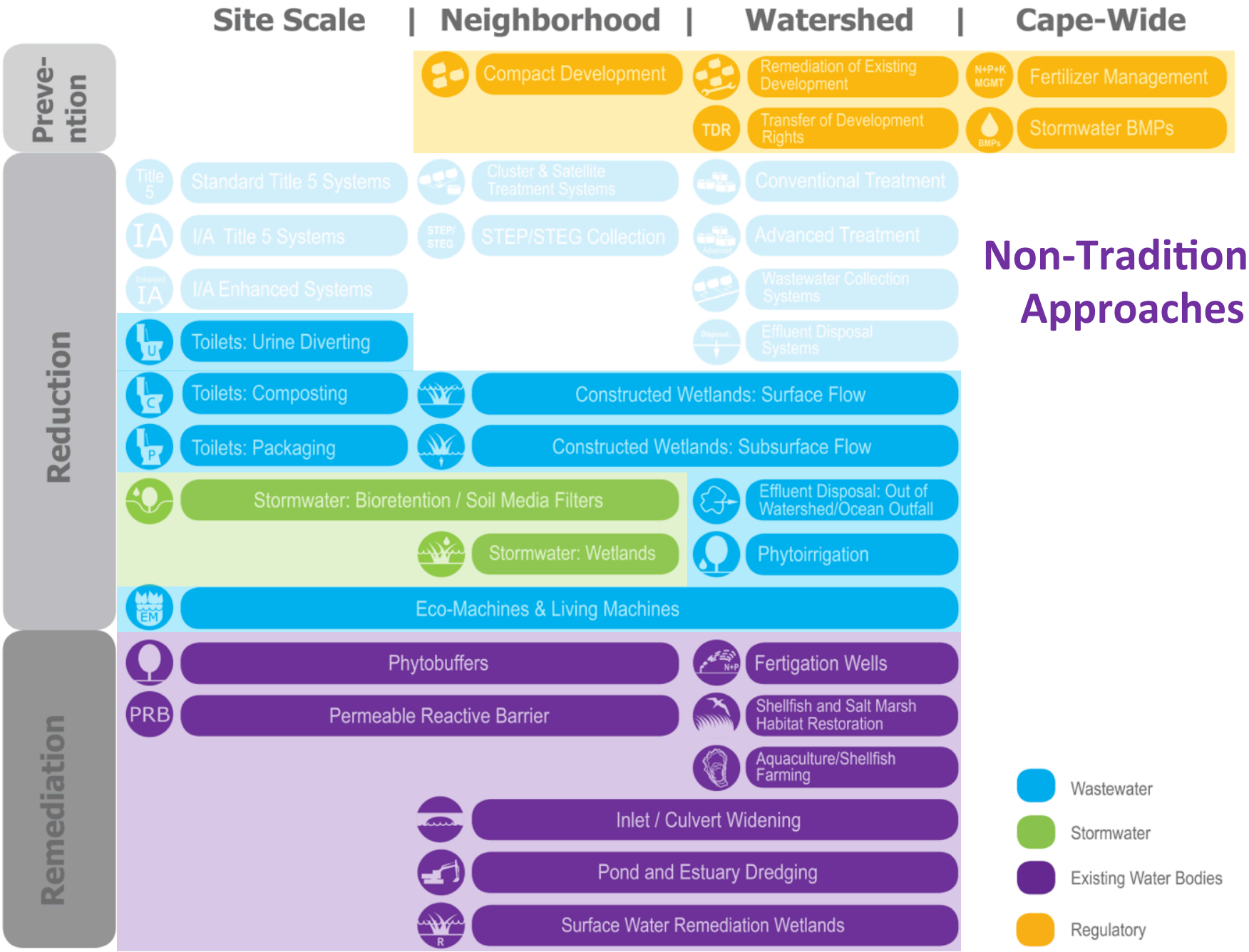
Regulatory

Targeted Centralized Treatment with a 50% Reduction in Fertilizer and Stormwater

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Problem Solving Approach

Wastewater | Existing Water Bodies | Regulatory

1 2 3 4 5 6 7

Targets/Reduction Goals

Present Load: X kg/day — **Target:** Y kg/day = **Reduction Required:** N kg/day

Other Wastewater Management Needs

A. Title 5 Problem Areas
B. Pond Recharge Areas
C. Growth Management

Low Barrier to Implementation

A. Fertilizer Management
B. Stormwater Mitigation

Watershed/Embayment Options

A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture

Alternative On-Site Options

A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

Priority Collection/High-Density Areas

A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

Supplemental Sewering

Watershed Calculator **Waquoit Bay**

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:		90.866	33,166
wastewater		64.142	23,412
fertilizer			4,184
stormwater			4,775
Target Nitrogen Load:		42.3	15,440
Nitrogen Removal Required:		**48.566**	**17,727**
Total Number of Properties:	7171		

Watershed Calculator **Waquoit Bay**

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
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Other Wastewater Management Needs	Ponds	Title 5 Problem Areas	Growth Management

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Other Wastewater Management Needs Ponds Title 5 Problem Areas Growth Management

Low Barrier to Implementation:	**Reduction by Technology (Kg/yr)**	**Remaining to Meet Target (Kg/yr)**	**Unit Cost ($/lb N)**
Fertilizer Management	2,292	15,435	
Stormwater Mitigation	2,585	12,850	

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Watershed/Embayment Options:				
Permeable Reactive Barrier (PRB)	879 homes	2,707	10,142	$452

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Constructed Wetlands	5	acres	2,830	7,312	$521

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Constructed Wetlands	5	acres	2,830	7,312	$521
Fertigation Wells	2	golf course	272	7,062	$438

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Fertigation Wells	2	golf course	272	7,062	$438
Oyster Beds/Aquaculture	17	acres	4,250	2,812	$0

Watershed Calculator **Waquoit Bay**

MEP Targets and Goals:			**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:			90.866	33,166
wastewater			64.142	23,412
fertilizer				4,584
stormwater				5,170
Target Nitrogen Load:			42.3	15,440
Nitrogen Removal Required:			**48.566**	**17,727**
Total Number of Properties:	7171			

Other Wastewater Management Needs Ponds Title 5 Problem Areas Growth Management

Low Barrier to Implementation:			**Reduction by Technology (Kg/yr)**	**Remaining to Meet Target (Kg/yr)**	**Unit Cost ($/lb N)**
Fertilizer Management			2,292	15,435	
Stormwater Mitigation			2,585	12,850	
Watershed/Embayment Options:					
Permeable Reactive Barrier (PRB)	879	homes	2,707	10,142	$452
Constructed Wetlands	5	acres	2,830	7,312	$521
Fertigation Wells	2	golf course	272	7,062	$438
Oyster Beds/Aquaculture	17	acres	4,250	2,812	$0
Floating Constructed Wetlands	2500	cu feet	1,125	1,687	$61

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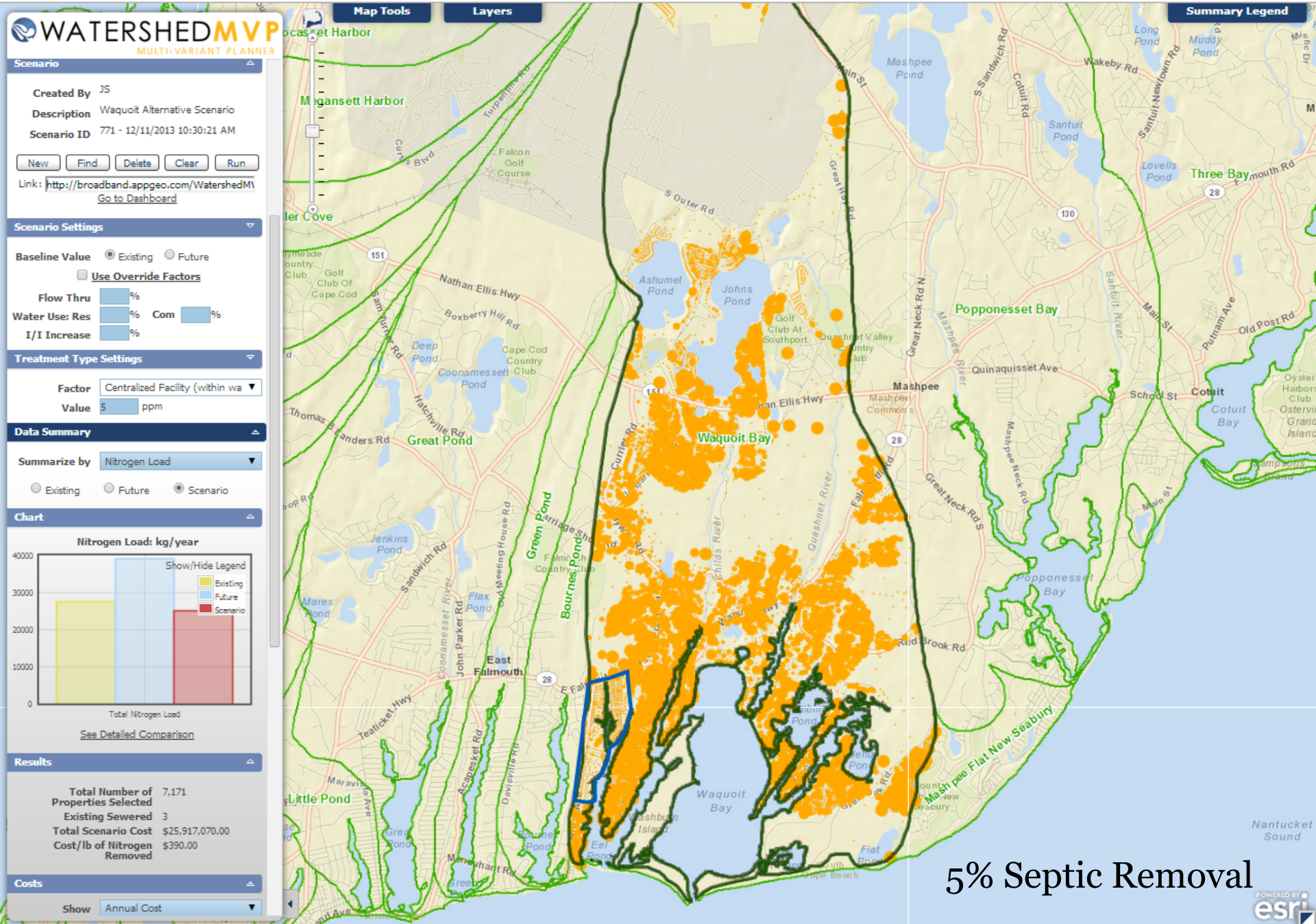
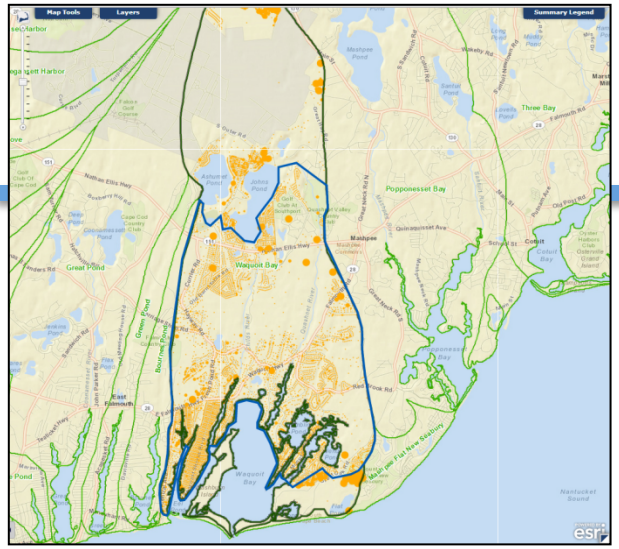
Alternative On-Site Options:					
Ecotoilets (UD & Compost)	187	homes	740	947	$1,265
Sewering	301	homes	1322	0	$1,000

Targeted Centralized Treatment after Applying Alternative Strategies (1322 kg N/yr)



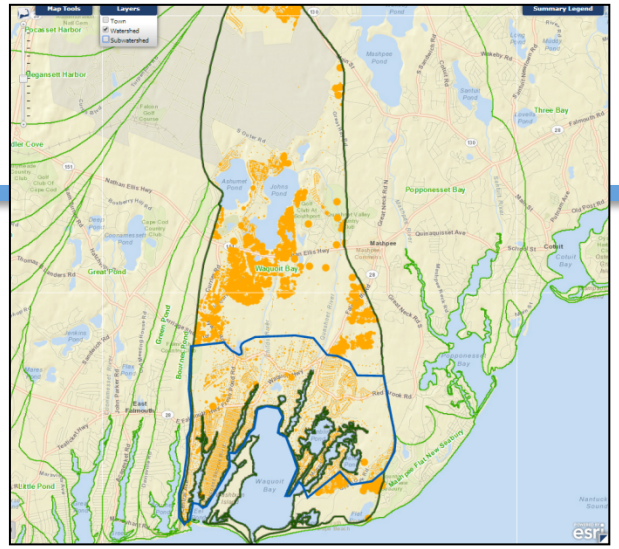
Scenario Comparison

Targeted Collection



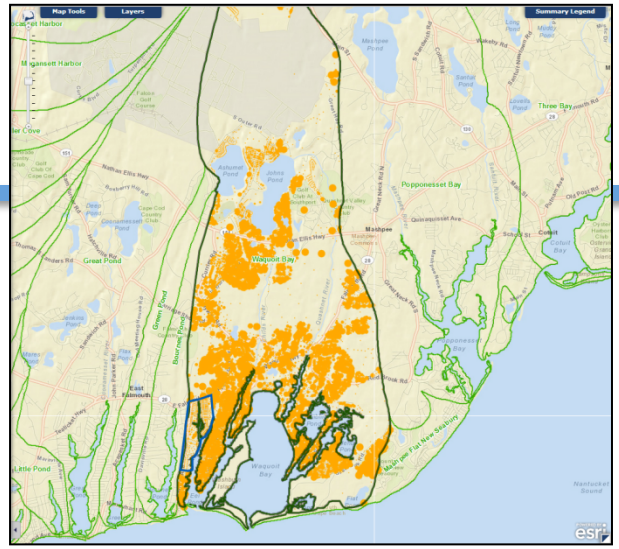
- Achieves TMDL[1]
- Cost/lb N = $527
- Treated Flow = 665,000 gpd

Targeted Collection after a 50% reduction in fertilizer and stormwater



- Achieves TMDL[1]
- Cost/lb N = $437
- Treated Flow = 443,000 gpd

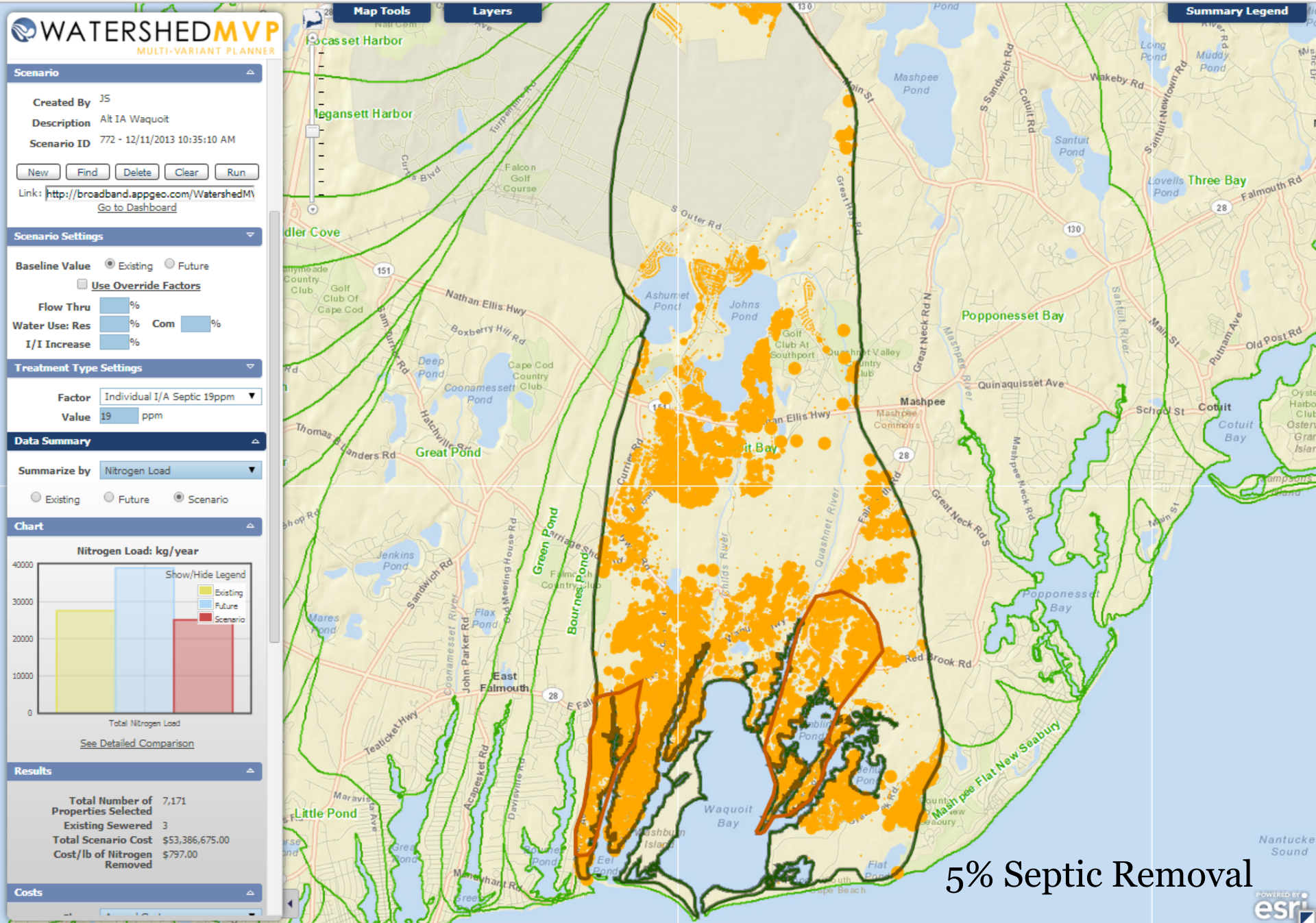
Targeted Collection after a 50% reduction in fertilizer and stormwater & after applying alternative approaches



- Achieves TMDL[1]
- Cost/lb N = $402
- Treated Flow = 47,000 gpd

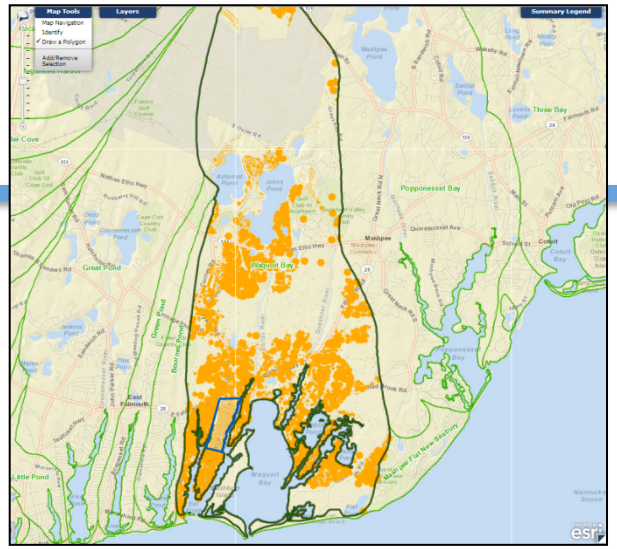
[1] within 5% of goal

Innovative/Alternative On-Site Systems after Applying Alternative Strategies (1322 kg N/yr)



Scenario Comparison

Targeted Collection after a 50% reduction in fertilizer and stormwater & after applying alternative approaches



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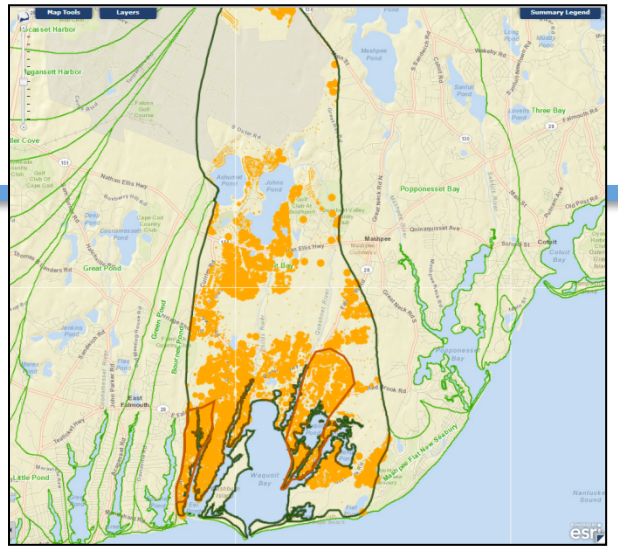


- Achieves TMDL[1]
- Cost/lb N = $912
- Treated Flow = 135,000 gpd

[1] within 5% of goal

Adaptive Management:

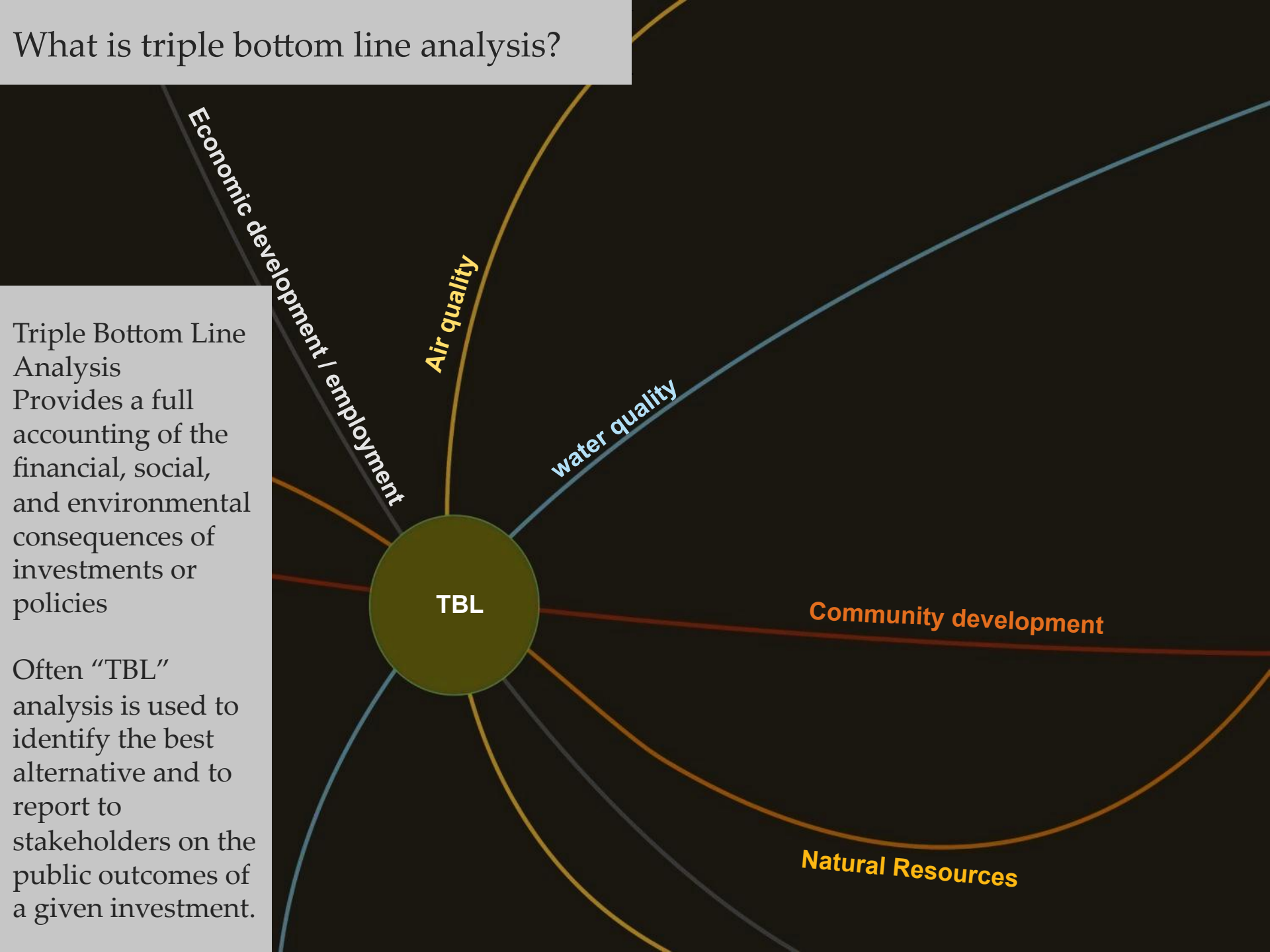
A structured approach for addressing uncertainties by linking science and monitoring to decision-making and adjusting implementation, as necessary, to increase the probability of meeting water quality goals in a cost effective and efficient way.

Triple Bottom Line (TBL) Introduction

What is triple bottom line analysis?

Triple Bottom Line Analysis Provides a full accounting of the financial, social, and environmental consequences of investments or policies

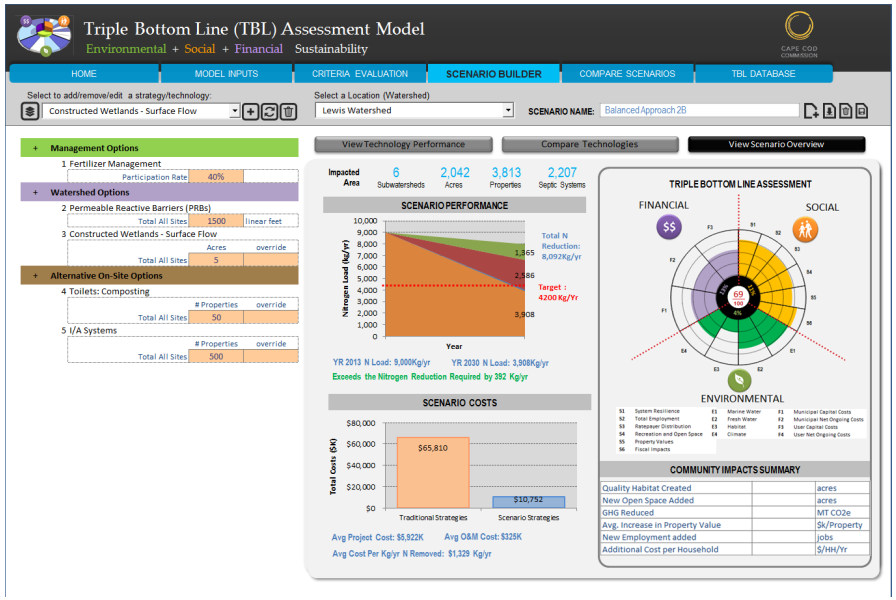
Often "TBL" analysis is used to identify the best alternative and to report to stakeholders on the public outcomes of a given investment.

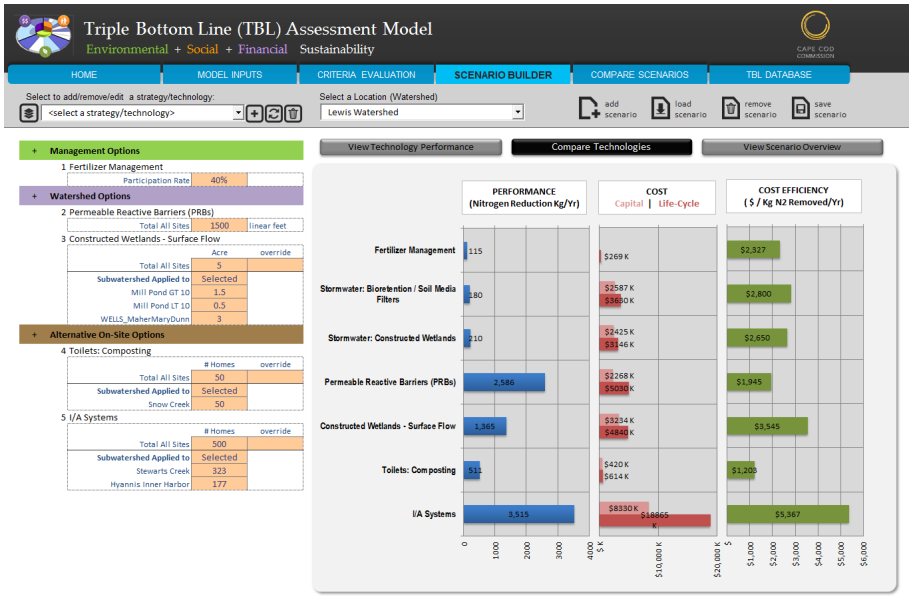


Why develop a TBL model?

- To consider the financial, environmental, and social consequences of water quality investments and policies in Cape Cod.

- TBL Model evaluates the “ancillary” or downstream consequences of water quality investments not the direct Phosphorous or Nitrogen levels.





Triple Bottom Line (TBL) Assessment Model

Environmental + Social + Financial Sustainability

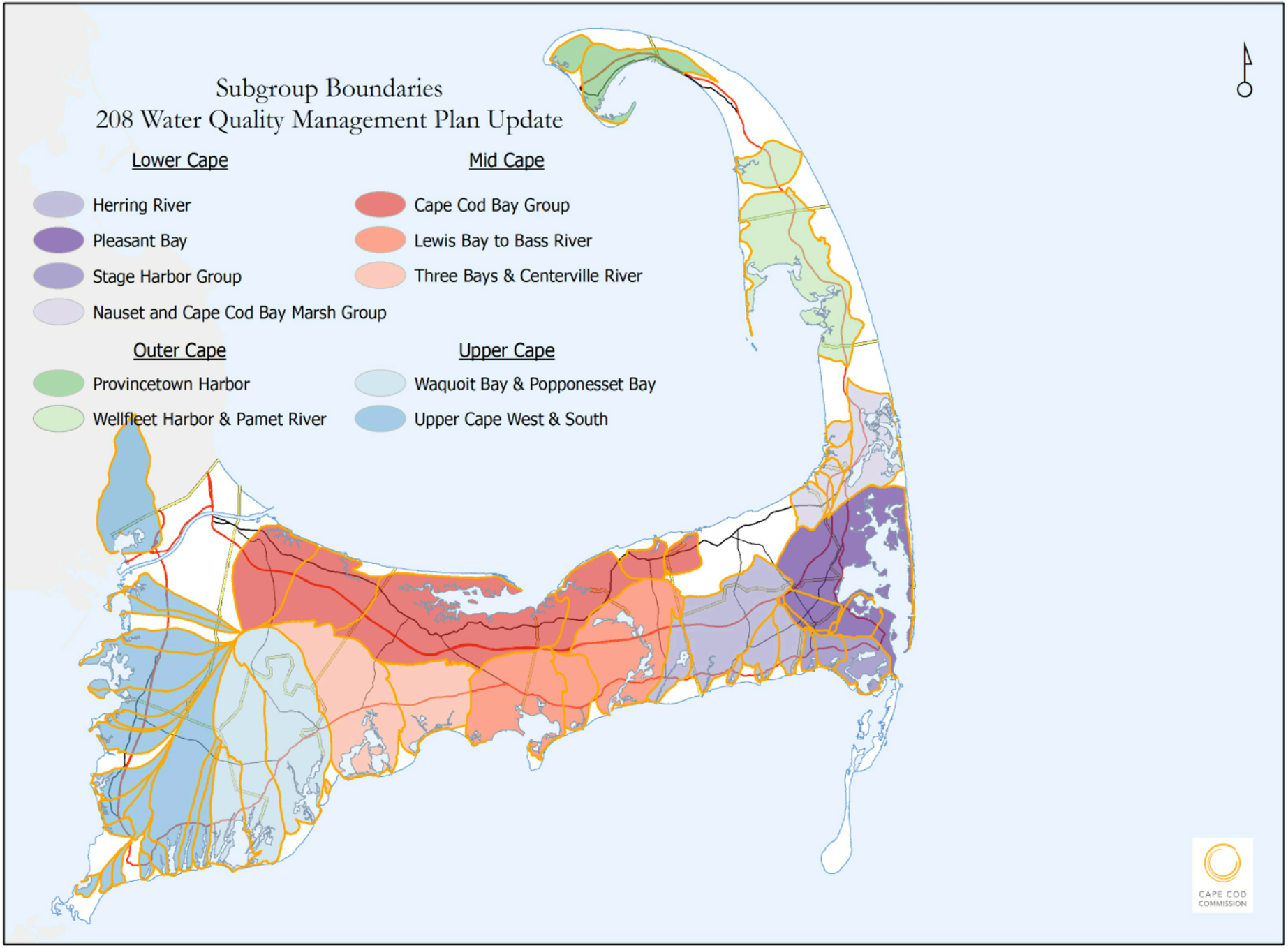
CAPE COD COMMISSION

Criterion Scores

SOCIAL	
System Resilience	S1
Employment	S2
Ratepayer Distribution	S3
Recreation and Open Space	S4
Property Values	S5
Fiscal Impacts	S6
ENVIRONMENTAL	
Marine Water	E1
Fresh Water	E2
Habitat	E3
Climate	E4
FINANCIAL	
Municipal Capital Costs	F1
Municipal Other Costs	F2
Property Owner Capital Costs	F3
Property Owner Other Costs	F4

Strategy/Technology Distribution

	Scenario 1	Scenario 2	Scenario 3
	Minimum Cost	Cost Effective	Maximum Performance
			
			
COST & PERFORMANCE			
Nitrogen Reduction %	30%	52%	61%
Remaining Nitrogen Load (Kg N)	8,400	5,760	4,680
Life Cycle Costs ($K)	$5,922	$7,350	$9,800
Municipal O&M Cost ($K)	$325	$425	$610
Municipal Project Cost ($K)	$1,329	$1,600	$1,800
Property Owner O&M Cost ($K)	$98	$128	$183
Property Owner Project Cost ($K)	$397	$480	$540
COMMUNITY BENEFITS			
Quality Habitat (acres)	0.5	1.8	2.4
New Open Space Added (acres)	1.5	4.6	5.0
GHG Reduced (MT CO2e/yr)	2.1	3.1	3.3
Avg. Increase in Property Value ($/pty)	$200	$1,200	$2,000
New Employment Added (jobs)	152	188	252
Additional Cost per Household ($/HH/yr)	$20	$26	$37


Subgroup Boundaries
208 Water Quality Management Plan Update
Lower Cape
Herring River
Pleasant Bay
Stage Harbor Group
Nauset and Cape Cod Bay Marsh Group
Mid Cape
Cape Cod Bay Group
Lewis Bay to Bass River
Three Bays & Centerville River
Outer Cape
Provincetown Harbor
Wellfleet Harbor & Pamet River
Upper Cape
Waquoit Bay & Popponesset Bay
Upper Cape West & South
CAPE COD COMMISSION

Area Boundaries
208 Water Quality Management Plan Update